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POLLUTION OF THE MISSISSIPPI RIVER NEAR NEW ORLEANS

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POLLUTION OF THE MISSISSIPPI RIVER NEAR NEW ORLEANS

Frank W. Macdonald,* M. ASCE

SYNOPSIS

The object of this study is to determine the degree of pollution of the Mississippi River as it reaches the City of New Orleans, and to determine the effect on the quality of water by wastes of the city that are discharged into the river.

The report reviews the bacteriological records from the year 1934. Correlation of these records with the variation in the stream flow is made. Results are compared with the water quality standards now in use in various sections to determine (1) the suitability of the Mississippi River water as a source of raw water supply for treatment plants and (2) the suitability of present standards as a means of evaluating raw water supply quality.

Data is presented to demonstrate that monthly averages of the MPN is a poor index of stream pollution. One or two extremely high daily figures during a month distort the averages to such an extent that they do not give a true representation of the general conditions for the period. The monthly median or geometrical mean is suggested as a better index for representing the true conditions of the period. Sampling practice is also discussed in the report. The MPN varied with stream flow, the greater values occurring generally during minimum flows.

INTRODUCTION

The pollution of the waterways of the United States is a major problem confronting the growth of our nation. For many years with little regard to consequences we have been polluting many of our surface waters with municipal and industrial sewages. Although considerable progress has been made in recent years in the construction of disposal plants for the treatment of the liquid wastes of our communities, the rapid growth of our cities and industrial operations is steadily resulting in an increase in stream pollution in many sections of our country. The condition of our waterways has deteriorated to the extent that it is now estimated(1) that the industrial and domestic wastes discharged to streams, lakes and bays are equivalent to the raw sewage from the population of the entire United States.

The seriousness of the problem has been recognized by many states through the establishment of water pollution control laws and standards of water quality. In many sections interstate commissions have also been formed to provide more adequate control of those streams flowing through several states. The efforts of these states and interstate agencies have done much to check the degeneration of our streams. The Congress of the United States has also considered this matter with increasing alarm for many years and in June 1948 it passed the Federal Water Pollution Act, Public Law 845.(2) This Act, passed

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by the 80th Congress, delegates to the Public Health Service the responsibility of developing programs to improve and conserve the Nation's sources of water supplies.

The passage of this act together with the appropriations which it authorizes for expenditure on research and the construction of disposal facilities, has done much to provide the stimulus that was needed so greatly to speed up our national stream pollution control program.

The Mississippi River basin extends from New York to Idaho and from Canada to Louisiana. It passes through twenty-seven states and carries the sanitary sewage of millions of persons and the industrial wastes from hundreds of industrial plants located in the drainage basin.

Together with its tributaries it drains most of the sections of the United States between the Rocky and Alleghany Mountains, an area of 1,232,000 square miles, or approximately one-third of the total area of the United States. Thirteen thousand square miles of additional drainage area of the river lies in Canada. The drainage area of the Mississippi River is exceeded only in size by the Amazon and Congo Rivers.

The Mississippi River is estimated[3] to have over 100,000 tributaries, forty-five of these being large enough for navigation over a total distance of 15,700 miles. The average annual rainfall on the drainage basin is 29.8 inches, of which approximately 25 per cent reaches the river and its tributaries as run-off, eventually flowing to the sea. The annual discharge of water is approximately 785,190,000,000 cubic yards, and the annual amount of sediment carried to the Gulf of Mexico is 406,250,000 tons.

The objective of this study is to determine the degree of pollution of the Mississippi River as it reaches the City of New Orleans, and to determine the possible effect on the quality of water by wastes from the city discharged to the river. Records are available of the bacteriological examination of samples collected from the Mississippi River in this area from the year 1934. The samples collected during this period were examined in the laboratory of the Louisiana State Department of Health. The results of these samples had not been compiled or tabulated in the past to determine the possible increase of pollution of the river in recent years. This report attempts to review these records and to correlate the results with the variation in the discharge in the Mississippi River. The results of these samples are also compared to the water quality standards now in use in various sections to determine (1) the suitability of the Mississippi River as a source of raw water supply for treatment plants and (2) the suitability of present standards as a means of evaluating raw water supply quality.

Water samples have also been collected and examined during an extremely low water period of the Mississippi River which occurred in the summer and fall of 1952. Chemical and bacteriological tests used as measures of pollution were performed on these samples to determine the quality of the river water and the results of these were compared to the standards to determine the suitability of the Mississippi River as a source of supply.

The Bacteriological Survey

In reviewing the bacteriological records of the nineteen year period considered, it must be realized that the values obtained may be influenced by (1) variations in the technique of the bacteriologist; (2) changes in laboratory procedures; (3) variations in sampling collection procedures; and (4) the unreliability of the M.P.N. test as an index of the number of the coliform organisms.

Many changes may take place in laboratroy personnel during the interim

involved that would affect the accuracy of the results. In the determination of the Most Probable Numbers of coliform organisms in a raw water supply, some bacteriologists may be more competent or efficient than others; the technician must also be constantly alert to changes occuring in the water. Dilution factors must be varied frequently to insure a sufficient spread to prevent the portions of water used from showing positive results in all tubes.

Changes also occur in the methods of analysis and in the confirmatory media used that may cause variations in the final results. The bacteriological examination of water samples required under the provisions of the Drinking Water Standards is that set forth in the Standard Methods for the Examination of Water and Sewage, prepared, approved and published by the American Public Health Association and the American Water Works Association. The procedures recommended for bacteriological examination of water samples in the 1936[4] Standard Methods differ materially from those in the 1946[5] edition.

Over a period of years such as that considered in this investigation, it is also quite likely that changes would occur in collecting samples and variations develop in collection technique that would also effect the results of the examinations. Through carelessness some collectors may introduce contamination to the samples collected.

Of great importance also in the degree of accuracy of the final results, is the effectiveness of the bacteriological test as an index of the Most Probable Numbers of coliform in samples of water. A review of the records shows many variations in the M.P.N. values on successive days. For example, the following M.P N.'s were reported in the Algiers intake (see Fig. No. 2) water during January, 1943:

Date	M.P.N.
Jan. 11, 1943	2400
Jan. 12, 1943	24,000
Jan. 13, 1943	2400
Jan. 14, 1943	240,000
Jan. 15, 1943	2400

It may be noted that on January 14 the results were one hundred times those recorded on the previous and the following days. It does not seem likely that the average condition of the stream would show such marked changes in a day's period, but yet conditions such as these were found in many instances in the records. These differences are probably due to irregular distribution of the organisms in the samples and discrepancies in the bacteriological test.

In order to investigate the possible inaccuracies in the bacteriological results due to irregular distribution of organisms in the Mississippi River water and discrepancies in the coliform test, groups of samples were collected from the Algiers and Carrollton (See Fig. No. 2) supplies. From each of the plants, five samples were collected rapidly within as little time interval as possible, and two each additional samples were collected for two successive hourly intervals. On the following page is a tabulation of the results of the Most Probable Numbers of these samples:

The samples from the Algiers plant were collected on October 28, 1952, and those from the Carrollton plant were collected on October 30, 1952. Wide variations in the results may be noted from the tabulation. For example, of the five samples collected at 9:00 a.m. from the Algiers supply, one of the samples showed a M.P.N. ten times as great as a second sample collected at the same time. These results indicate the variations that can be expected and

Bacteriological Results of Samples Collected on Hourly Intervals		
Time	Algiers M.P.N.	Carrollton M.P.N.
9:00 a.m.	14,000	79
9:00 a.m.	24,000	110
9:00 a.m.	35,000	130
9:00 a.m.	54,000	130
9:00 a.m.	160,000	350
10:00 a.m.	7,900	33
10:00 a.m.	35,000	79
11:00 a.m.	13,000	130
11:00 a.m.	54,000	240

show that there is much need for improvement in the procedures used for determining the number of coliform organisms in surface water samples. The results also show that single samples collected daily do not give satisfactory results on the bacterial content of surface supplies.

The bacteriological survey included a review of the results of the examinations of raw river water samples collected by the New Orleans Sewerage and Water Board in the vicinity of the City of New Orleans from 1934 through 1952.

Two sampling points have been used by the New Orleans Sewerage and Water Board for the period under consideration. These are the Carrollton Water Purification Plant serving the East Bank of the City of New Orleans, and the Algiers Water Purification Plant serving the West Bank of the city. The locations of these plants are indicated by points 1 and 4 on Figure 1. Single samples of the river water were collected daily with the exception of Sundays and holidays from each sampling point and the results of the examination have been recorded in the operation records of the two plants.

For the period 1934 through 1939 the average monthly M.P.N. values were tabulated and plotted on logarithmic graphs. For the period 1940 through 1952, the average M.P.N. and the median, high and low M.P.N. values for each month were tabulated and plotted on logarithmic graphs. The data on these examinations were obtained from the records kept at the Carrollton Water Purification Plant of the New Orleans Sewerage and Water Board.

Samples were also collected during 1952 by the writer from the Mississippi River at the American Sugar Refinery. This sampling point is indicated by the number "3" on Figure 1. Its location is downstream from the City of New Orleans and approximately one and one quarter miles below the last sewer outfall.

In order to analyze the results of the bacteriological examinations of water samples collected from the river, it is necessary to consider stream flow as well as the Most Probable Numbers of coliform organisms present. The average monthly discharges of the Mississippi River as measured at the City of New Orleans were obtained from the offices of the United States Corps of Engineers in New Orleans. These were tabulated and plotted with the results of the M.P.N. values.

Analysis of Bacteriological Examinations

If the water quality standards limiting the coliform bacteria to not more than 5000 coliform organisms per 100 ml. in any month are used as a criterium, it may be seen that Algiers and Carrollton sources of supply exceeded the figure on many occasions.

The following is a tabulation of the yearly totals for this period:

Number of Times During Year Monthly Averages Exceeded 5000 M.P.N.

Year	Algiers	Carrollton
1934	2	1
1935	6	0
1936	7	1
1937	5	0
1938	7	1
1939	6	0
1940	7	1
1941	10	5
1942	6	6
1943	6	0
1944	5	4
1945	4	2
1946	1	0
1947	7	1
1948	7	2
1949	10	12
1950	12	12
1951	9	2
1952	7	1
Total	124	51

These figures show that in the nineteen year period involved, the 5000 M.P.N. figure was exceeded during 124 months or 51 per cent of the period in the Algiers supply and during 51 months or 22 per cent of the period in the Carrollton supply.

In reviewing the data on the bacteriological examination of the water samples, it was noted that on many occasions the daily results were reasonably low for the month, with the exception of one or two days when exceptionally high figures were recorded. These high figures for the few days involved, when averaged in with the lower daily figures for the rest of the month, gave unusually high averages and a distorted picture of the mean condition for the period. As an example of this, in January, 1943, the Algiers record showed all daily readings to be 2400 M.P.N. or less, with the exception of two days when the counts were 240,000 M.P.N. and 24,000 M.P.N. The figure of 240,000 alone when averaged over the month's period, results in a net increase in the average of 8000. For the month of January, the average was recorded as 13,460, whereas if the two high figures referred to had not been included, the average would have been 1970, a difference in the Most Probable Number of over 11,000. The median for the same month was found to be 2400 M.P.N.

In reviewing further the figures for Algiers for the year 1943, it was found that for February, when only one daily 24,000 M.P.N. was recorded, the average for the month dropped to 2280, whereas in March, when two 240,000 daily figures were recorded, the average increased again to an extremely high figure of 25,500.

These high figures and the affect on the average results indicated the desirability of analyzing the records from the standpoint of median values. Accordingly, for the periods 1940 through 1952 the median, high and low Most Probable Numbers were determined. These results were tabulated and illustrated by graphs.

The following is a tabulation by year of the average and median figures for the number of months per year the Most Probable Numbers exceeded 5000 coliform bacteria per 100 ml:

Number of Months During Year Average and Median Exceeded 5000 M.P.N.

	ALGIERS		CARROLLTON	
Year	Average	Median	Average	Median
1940	7	2	1	0
1941	10	2	5	0
1942	6	0	6	0
1943	6	0	0	0
1944	5	0	4	0
1945	4	0	2	0
1946	1	0	0	0
1947	7	4	1	0
1948	7	2	2	0
1949	10	7	12	7
1950	12	12	12	12
1951	9	5	2	2
1952	7	6	1	0
TOTAL	91	40	48	21

These results seem to indicate clearly the desirability of using the monthly median as an index in the Standard of Water Quality rather than the monthly average. The averages are likely to give a very distorted picture of the general quality of the water, whereas the median appears to give a truer representation of actual conditions. The value of the geometrical mean as an index was also considered through the analysis of the records for the year 1951. The geometrical mean of each month was determined for the Algiers and Carrollton supplies. The tabulation of these data is shown on Tables 1 and 2, where comparisons can be made with the average and median values also listed. The geometrical mean appears to represent the general conditions of water quality better than the arithmetic averages, and it may be noted also that these values correspond very closely with the median values. As comparable results are obtained from the median and geometrical mean, and as considerable computations are involved in the determination of the geometrical mean, it is believed that the median is better suited for computations to determine the index of water quality.

As a further comparison between the average and the median as an index of water quality, monthly summaries were prepared for the periods 1940 through 1952. Tables 3 and 4 show the tabulation of this material. Table 3 represents the averages of monthly discharge averages and monthly M.P.N. of the Carrollton and Algiers plants. It may be noted that for all months, the averages exceeded the usual water quality standard of 5000 coliform organisms per 100 ml. of sample. These high figures are undoubtedly due to the exceptionally large values that were recorded for the period extending from the latter part of 1949 through the beginning of the year 1951. These averages, varying over 200,000 in many months, are so far out of line with the results found before and after this period, that distorted figures are obtained when monthly averages are determined. The discrepancy during this period may also have been due to changes occurring in laboratory procedures or personnel.

A similar comparison by using median values is illustrated by the tabulation shown in Table 4. In this case the median of the monthly average river discharges was used and the medians of monthly medians of the Algiers and Carrollton M.P.N.'s were determined. These results indicate a much different condition as far as the general quality of the water is concerned. Throughout the thirteen year period the M.P.N.'s hold fairly constant to a 2400 figure.

Comparison of Water Quality of Carrollton and Algiers Plant

A review of the materials assembled shows that consistently throughout the years the M.P.N.'s of the Algiers raw water supply have been higher than those at Carrollton. This condition is also indicated in Tables 3 and 4, which show summaries of the monthly averages and medians of the two plants. Without exception the monthly averages of Algiers exceeded those at Carrollton. To the knowledge of the sanitary engineers of the Louisiana State Department of Health and the City of New Orleans Health Department, no domestic sewage is discharged to the river from the City of New Orleans or from any of the sewered suburban areas between the inlets of these two plants. Those sewered sections of the City of New Orleans and the surrounding territories discharge the untreated sewage to the river downstream from both of the plants, at points indicated on Figure 1.

The higher figure at the Algiers plant is perhaps due to a number of small sources of pollution entering the stream between the plants, such as: (a) squatters living along the edge of the river; (b) ships in the City of New Orleans harbor; and (c) wastes from industrial plants located in unsewered areas.

Effect of River Discharge on Bacteriological Results

The discharge of the Mississippi River at the City of New Orleans was tabulated for the period 1934 through 1952. A review of these data, together with the graphic illustration of the stream flow and bacteriological results, shows that in general the bacterial content is inversely proportional to stream flow. The greatest river discharge occurs during the spring of the year when the M.P.N.'s are usually lower and the lowest discharge occurs in the fall when maximum M.P.N.'s are observed. The best illustration of the effect of the river discharge on bacterial content is shown in Table 3, which is a tabulation of the average of the monthly averages for the period 1940 through 1952. This material plotted on a logarithmic graph, as illustrated in Figure 2, shows a definite pattern of variation of M.P.N.'s to stream flow. The results do not indicate, however, that accurate predictions could be made of the expected M.P.N. value for a specific stream discharge.

Extremely low M.P.N. occurred occasionally in the Carrollton samples during periods of low discharge. This was probably due to unfavorable environment in the river and sedimentation of the organisms in the river because of low velocities.

The Chemical Survey

A stream is not simply a large moving mass of water. It is a living artery, teeming with microscopic life and undergoing continuous complex changes. Most streams contain a variety of living organisms such as bacteria, protozoa, crustacea and fish which utilize waste organic matter in the water as a source of food. This process is known as self-purification of streams.

The purification process is a complex one, the success or failure depending upon many variables. The principal factors involved are the quantity of polluting material and the volume of diluting water. As oxygen is essential for the bacterial decomposition processes, the size of the waterway, together with its velocity and turbulence, will govern the ability of the stream to assimilate oxygen from the atmosphere through the procedure known as aeration. The amount and type of sewage discharged to the body of water will also govern to a great extent the efficiency of the self-purification process. The strength of waste material from many industries is often more complex and more difficult

to purify than domestic sewage from municipalities and consequently may have a greater polluting effect on streams than the sewage from municipalities.

Nature is very adept at maintaining a controlling influence on the self-purification processes. As stream pollution increases, there is a natural tendency for the microscopic lift to increase proportionally so as to render to the stream the assistance required in purifying the water. Under normal circumstances a natural balance exists between food supply and organisms, with the stream supplying the needed life blood in the form of oxygen through its reaeration processes. When the balance is upset, either through insufficient oxygen or too large quantities of waste materials in the stream, the self-purification processes are retarded and pollution results.

The chemical indices of pollution of water are Dissolved Oxygen (D.O.) and Biochemical Oxygen Demand (B.O.D.). The role of dissolved oxygen in surface waters is a very important one. Oxygen is derived at the water surface through solution from the air and by the process of photosynthesis that takes place in green plants. The principal source of photosynthesis is through the oxygen production of algae, minute plant life often found in clear surface supplies.

The amount of dissolved oxygen that a stream may contain is expressed in terms of parts per million (p.p.m.) by weight. A clean stream may contain a full quota of oxygen, referred to as a saturated dissolved oxygen content. The solubility of oxygen in water varies with temperature.

Dissolved oxygen is essential in surface supplies in order to sustain fish life. At a saturation content of 70 per cent, fish life begins to disappear and at a 40 per cent saturation content, only lower forms of life remain.

Dissolved oxygen also plays a very important role in the self-purification of surface waters. When putressible organic matter is discharged into bodies of water, the oxidation of the organic matter begins immediately through the growth and activity of aerobic bacteria. These organisms, as long as sufficient oxygen is present, nitrify or oxidize the organic matter resulting in the self-purification of the stream. The process results in a lowering of the dissolved oxygen of the stream which may be added to by the addition of fresh dilution water from tributaries and reaeration through the movement of the water. The degree of rapidity of the self-purification process will depend on the stream flow, initial dissolved oxygen content, amount of organic matter, temperature and velocity of flow.

A second chemical test used for measuring pollution is the Biochemical Oxygen Demand, which is defined as the amount of oxygen required to maintain aerobic conditions during decomposition. This test is used for measuring the oxygen requirements or oxygen demand of waste liquids. The procedure followed is that recommended in the Standard Methods for Examination of Water and Sewage, and consists of diluting a sample of liquid waste with a known quantity of water saturated with dissolved oxygen. The dilution water and waste are incubated at a temperature of 20° C for a period of five days. The amount of oxygen consumed in the mixture during the five-day incubation period makes it possible to determine the oxygen demand of the sample. The results are expressed in terms of parts per million by weight.

The many factors that effect stream pollution, together with the differences in problems existing in various sections, make it exceedingly difficult to develop a set of standards that would serve all areas. Many states and interstate groups have established limits for waters depending upon the type of treatment of the supply that will be provided. The figures suggested by the California State Water Pollution Control Board in its 1952 edition of Water

Quality Criteria(6) appear to be one of the best sets of standards developed. These were assembled by the California Board after a review of the standards available in other state and interstate groups. The recommended chemical standards are shown in Table 5.

It may be noted that three classes of water supplies are included, and that limits are set forth for B.O.D.'s on a monthly average and maximum daily figure. As individual samples were collected during the survey, the comparison of the data will be made with the maximum daily allowance. Dissolved oxygen is listed both in terms of parts per million and per cent saturation. The latter figure is the ratio of the amount of dissolved oxygen existing in the stream as compared to the amount the water could hold if saturated to one hundred per cent. The Biochemical Oxygen Demand, Dissolved Oxygen and Most Probable Number test are the most important in the evaluation of stream water quality. These were the only tests used in the study of the Mississippi River.

The survey conducted on the Mississippi River in the vicinity of New Orleans included collecting samples from three points for determining the B.O.D. and D.O. of the river water. During the period from July through December, 1952, eighteen samples were collected from the following points:

1) Carrollton Water Purification Plant
2) Andry Street
3) American Sugar Refinery

The locations of these sampling points are shown on Figure 1. The Carrollton plant sample was collected from the wharf at the intake of the plant; the Andry Street sample from the wharf of the Yacht "Good Neighbor"; and the American Sugar Refinery from the wharf located at Chalmette. All samples were collected with a standard dissolved oxygen sampler, and the sampling points in each case were approximately 50 feet from the shore line.

As appreciable amounts of nitrates are likely to be present in surface water, the Alsterberg or Sodium Azide Modification of the Winkler process was used for determining the dissolved oxygen.

Analysis of Chemical Tests

Tables 6 and 7 show the results of the dissolved oxygen and biochemical oxygen demand tests. Figures 3 and 4 show the plotted data.

The quality of the water at the Carrollton plant appears to be good. The average of the eighteen B.O.D. values is well below 1.0 p.p.m. and the individual readings are all below the 3.0 p.p.m. value listed for good sources of water supply requiring usual treatment, such as filtration and disinfection. The dissolved oxygen content is also satisfactory on an average basis and well within the required per cent saturation for the temperature of the collection of the samples. It could be said, therefore, that using these standards as criteria, the chemical quality of the Mississippi River water at the Carrollton plant is satisfactory.

The second sampling point at Andry Street is approximately 1000 feet below the last sewer outfall of the City of New Orleans. For this location, the biochemical oxygen demand and dissolved oxygen results are remarkably good, considering the proximity of the sewer outfall. The great dilution powers and recovery ability of the Mississippi River are illustrated by relatively high dissolved oxygen content for all the periods considered. Only on three occasions did the B.O.D exceed 4.0 p.p.m. and was greater than the allowance set forth for waters that might be used by water treatment plants.

The last sampling point at the American Sugar Refinery further illustrates

the remarkable recovery power of the Mississippi River. With but a few exceptions the dissolved oxygen had been completely regained by the stream, showing a content comparable to the samples collected on the same days from the Carrollton plant. The biochemical oxygen demand, although slightly higher than Carrollton, is well within the limits of those values set forth for sources serving water treatment plants.

CONCLUSIONS

1) The monthly averages of the Most Probable Numbers of coliform organisms used by many states and interstate groups is a poor index of stream pollution. One or two extremely high daily figures during a month distort the averages to such an extent that they do not give a true representation of the general conditions for the period.

2) Either the monthly median or the geometrical mean provide standards of water quality for Most Probable Number comparisons which better represent the true condition of the period. Both tend to minimize extreme values. However, the median is preferred to the geometrical mean as it involves less mathematical calculations.

3) In the bacteriological examination of raw water sources for the Most Probable Numbers at least two samples should be collected from each sampling point and analyses should be made on each sample. Results of single samples may not represent the true condition of the bacterial quality of the water.

4) The quality of the water of the Mississippi River at the intake of the Carrollton Purification Plant generally meets the accepted bacteriological standards if median values are used for comparison. The supply also meets the accepted standards for chemical quality.

5) The quality of the water at the Algiers Water Purification Plant does not on all occasions come up to the accepted standards for bacteriological quality.

6) An increase in the coliform content of river water is likely to occur in rivers as they flow through city harbors. This is indicated by the higher values of the Most Probable Numbers generally found at the Algiers plant over the Carrollton plant. This increase in the coliform content is probably due to a combination of small sources such as, ships in the harbor, squatters along the river and industrial wastes. Care should be taken in the selection of the inlet to water treatment plants with the site being preferably at a location upstream from the harbor area.

7) The Most Probable Numbers vary with the river discharge, the greater values occurring generally during minimum flows. Extreme low flows occasionally result in very low Most Probable Numbers, probably due to unfavorable environment and sedimentation of organisms in the river.

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COMPARISON OF AVERAGE - MEDIAN AND GEOMETRICAL MEAN OF MOST PROBABLE NUMBERS, ALGIERS, 1951

Month	Average M.P.N.	Median M.P.N.	Geometrical Mean M.P.N.
Jan.	222,520	240,000	192,000
Feb.	83,830	11,000	20,700
March	3870	2400	2180
April	3420	2400	2190
May	5480	3500	3190
June	5960	3500	3800
July	7320	3500	5280
Aug.	2440	1700	1800
Sept.	7000	5400	5020
Oct.	14,900	16,000	11,200
Nov.	8540	4300	4450
Dec.	8300	5400	7440

Table 1

COMPARISON OF AVERAGE - MEDIAN AND GEOMETRICAL MEAN OF MOST PROBABLE NUMBERS, CARROLLTON, 1951

Month	Average M.P.N.	Median M.P.N.	Geometrical Mean M.P.N.
Jan.	231,260	240,000	227,000
Feb.	99,200	9750	12,300
March	3580	2400	2070
April	2110	1400	1430
May	2920	2400	1970
June	3810	3500	3000
July	4210	3500	3580
Aug.	1620	1100	1180
Sept.	4480	3500	3420
Oct.	2000	2300	1670
Nov.	2940	2600	2390
Dec.	2590	2400	2380

Table 2

AVERAGE OF MONTHLY AVERAGES
1940 - 1952

Month	Discharge c.f.s.	Algiers M.P.N.	Carrollton M.P.N.
Jan.	595,000	26,400	22,700
Feb.	695,000	13,550	12,400
Mar.	815,000	9,600	5,150
Apr.	955,000	9,600	5,400
May	835,000	7,780	6,130
June	680,000	19,400	7,600
July	543,000	17,800	7,900
Aug.	327,000	23,700	17,500
Sept.	259,000	26,800	22,200
Oct.	254,000	37,600	25,000
Nov.	281,000	34,100	23,900
Dec.	394,000	30,800	22,200

Table 3

MEDIAN OF MONTHLY MEDIANS
1940 - 1952

Month	Discharge c.f.s.	Algiers M.P.N.	Carrollton M.P.N.
Jan.	575,000	2400	2400
Feb.	550,000	2400	2400
Mar.	740,000	2400	2400
Apr.	900,000	2400	2400
May	800,000	2400	2400
June	600,000	3500	2400
July	450,000	2400	2400
Aug.	250,000	2400	2400
Sept.	200,000	2400	2400
Oct.	225,000	2400	1300
Nov.	275,000	2400	2400
Dec.	350,000	2400	2400

Table 4

RANGES OF LIMITING AND THRESHOLD CONCENTRATIONS FOR RAW WATER
SOURCES OF DOMESTIC WATER SUPPLY

Constituents		Class-A	Class-B	Class-C
B.O.D. (5-day)	Monthly Ave.	0.75	1.5-2.5	2.0-5.5
	Max. Day, or sample	1.0	3.0-3.5	4.0-7.5
Coliform MPN per 100 ml.	Monthly Ave.	50-100	240-5000	10,000-20,000 (TVA)
	Max. Day, or sample	---	20% 5000 5% 20,000 (Bull.296 PHS)	
Dissolved Oxygen	p.p.m. average	4.0-7.5	2.5-7.0	2.5-6.5
	% saturation	50-75	25-75	---
pH	Average	6.0-8.5	5.0-9.0	3.8-10.5
Chlorides, max.	p.p.m.	50	250	500
Iron & Manganese(both)	Max. p.p.m.	0.3	1.0	15
Fluorides	p.p.m.	1.0	1.0	1.0
Phenolic compounds	Max. p.p.m.	none	.005	.025
Color	p.p.m.	0-20	20-70	150
Turbidity	p.p.m.	0-10	40-250	---

Class A-Excellent source of water supply, requiring disinfection only, as treatment
Class B-Good source of water supply, requiring usual treatment such as filtration, etc.
Class C-Poor source of water supply, requiring special or auxiliary treatment and disinfection

California State Water Pollutional Control Board

Table 5

DISSOLVED OXYGEN DETERMINATIONS - 1952

Date	Temperature Centigrade	Sampling Points Carrollton Plant	Andry Street	American Sugar Rfg.
July 3	30	5.9	4.8	5.0
July 10	30	6.8	6.0	6.4
July 17	29	6.2	6.4	6.2
July 24	29	6.0	5.0	5.4
July 31	29	6.3	5.8	5.3
Aug. 7	30	5.8	5.2	5.8
Aug. 14	30	6.0	5.8	7.1
Aug. 21	30	6.0	6.0	5.8
Aug. 29	29	6.2	4.9	5.2
Sept. 11	27	7.2	6.4	7.0
Sept. 17	27	6.8	6.0	6.0
Sept. 25	26	7.7	5.9	6.3
Oct. 11	23	7.6	6.8	7.2
Oct. 25	20	8.0	7.6	7.8
Nov. 7	17	9.8	9.8	9.6
Nov. 24	14	9.7	8.8	9.6
Dec. 5	14	9.6	9.4	9.8
Dec. 20	13	9.8	9.8	10.4

Table 6

BIOCHEMICAL OXYGEN DEMAND DETERMINATIONS

Date	Sampling Points Carrollton Plant	Andry St.	American Sgr.Rfg.
July 3	1.0	4.8	1.6
July 10	1.7	1.8	1.9
July 17	0.9	1.9	0.8
July 24	0.4	1.6	0.6
July 31	0.8	0.7	1.2
Aug. 7	0.3	1.6	0.5
Aug. 14	0.6	4.0	1.2
Aug. 21	0.1	1.1	3.1
Aug. 29	1.7	4.6	1.3
Sept. 11	0.2	1.6	1.1
Sept. 17	0.7	0.2	1.3
Sept. 25	0.7	2.0	0.7
Oct. 11	0.5	1.2	1.8
Oct. 25	0.4	1.8	0.7
Nov. 7	0.0	1.8	0.0
Nov. 24	0.9	1.6	1.6
Dec. 5	0.2	4.2	1.0
Dec. 20	1.2	2.3	2.0

Table 7

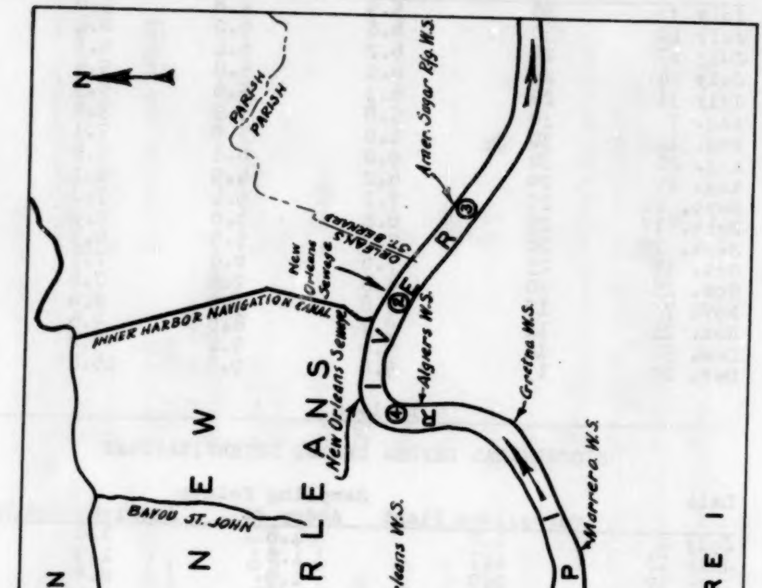
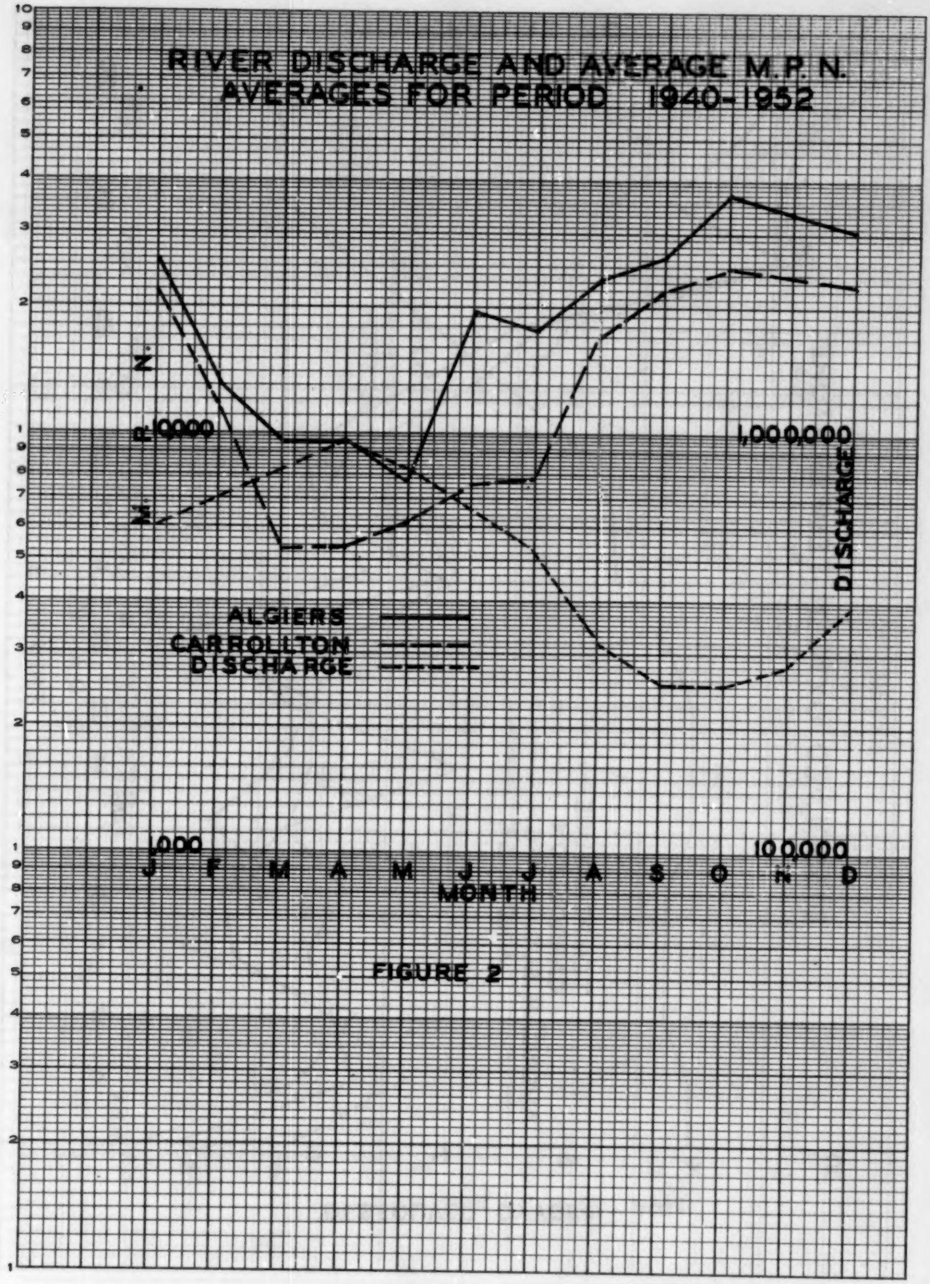

LAKE PONTCHARTRAIN
N
NEW ORLEANS
MISSISSIPPI RIVER
BAYOU ST. JOHN
INNER HARBOR NAVIGATION CANAL
ORLEANS PARISH
JEFFERSON PARISH
ORLEANS
ST. BERNARD
PARISH
PARISH
New Orleans Sewage
New Orleans Sewage
Algiers W.S.
Gretna W.S.
Marrero W.S.
Westwego W.S.
New Orleans W.S.
Amer. Sugar Rfg. W.S.
1
2
3
4

FIGURE I



RIVER DISCHARGE AND AVERAGE M.P.N.
AVERAGES FOR PERIOD 1940-1952
M.P.N.
10,000
1,000,000
DISCHARGE
ALGIERS
CARROLLTON
DISCHARGE
1,000
100,000
J F M A M J J A S O N D
MONTH

FIGURE 2

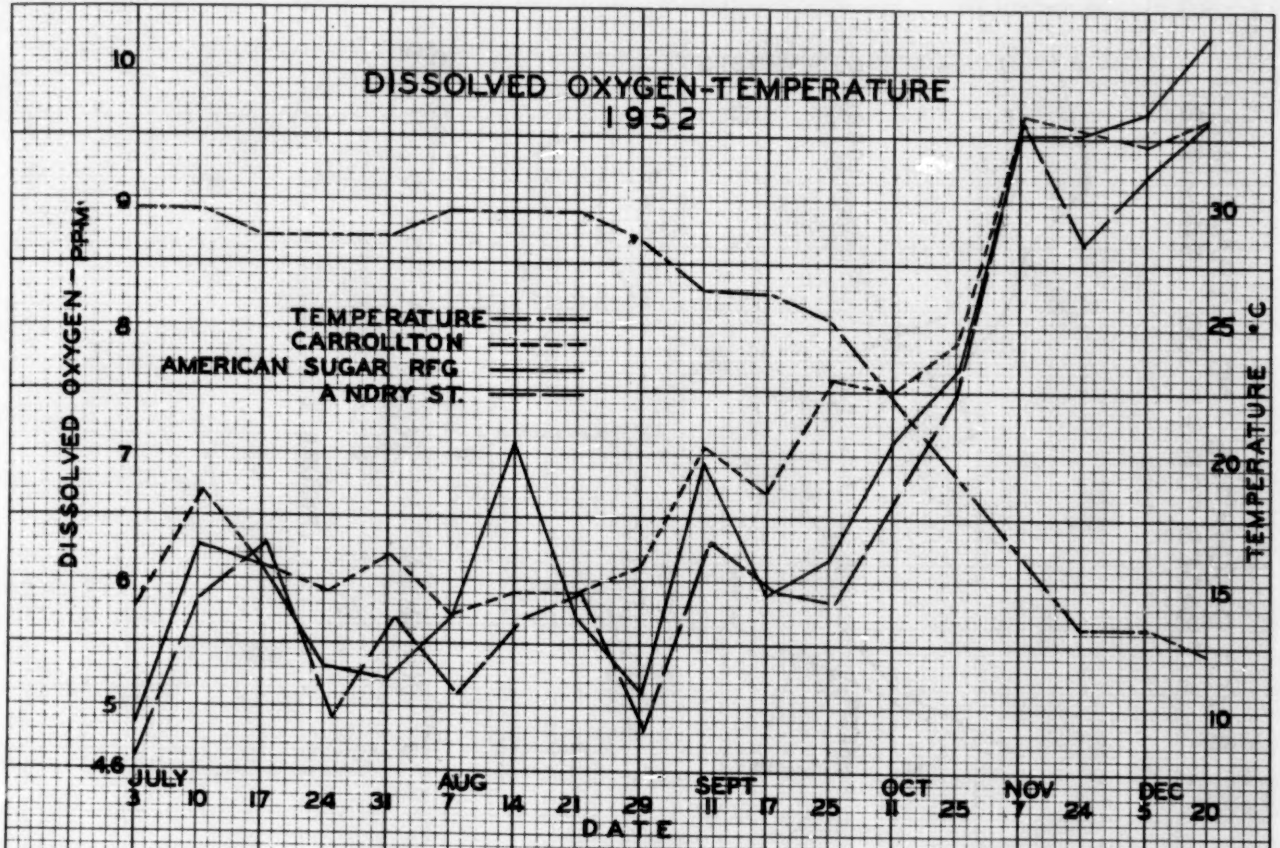

DISSOLVED OXYGEN-TEMPERATURE
1952
TEMPERATURE
CARROLLTON
AMERICAN SUGAR RFG
A NDRY ST.
DISSOLVED OXYGEN - PPM.
TEMPERATURE °C
DATE
10
9
8
7
6
5
4.6
30
25
20
15
10
JULY 3
10
17
24
31
AUG 7
14
21
29
SEPT 11
17
25
OCT 11
25
NOV 7
24
DEC 5
20

FIGURE 3

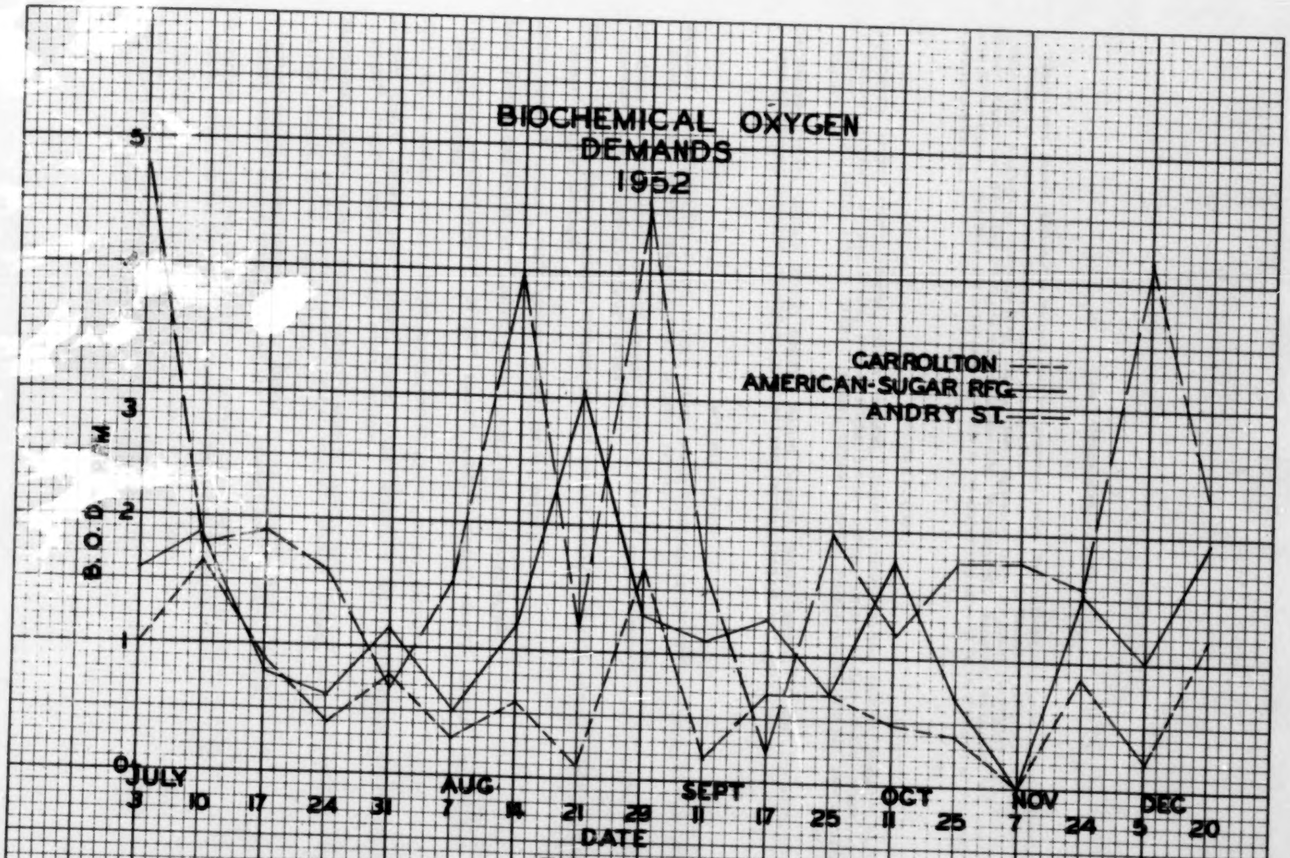

BIOCHEMICAL OXYGEN
DEMANDS
1952
CARROLLTON
AMERICAN-SUGAR RFG.
ANDRY ST.
B.O.D. PPM
0
1
2
3
5
JULY
3
10
17
24
31
AUG.
7
14
21
29
SEPT
11
17
25
OCT
11
25
NOV
7
24
DEC
5
20
DATE

FIGURE 4

PROCEEDINGS-SEPARATES

The technical papers published in the past year are presented below. Technical-division sponsorship is indicated by an abbreviation at the end of each Separate Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. For titles and order coupons, refer to the appropriate issue of "Civil Engineering" or write for a cumulative price list.

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NOVEMBER: 321(ST), 322(ST), 323(SM), 324(SM), 325(SM), 326(SM), 327(SM), 328(SM), 329(HW), 330(EM)[a], 331(EM)[a], 332(EM)[a], 333(EM)[c], 334(EM), 335(SA), 336(SA), 337(SA), 338(SA), 339(SA), 340(SA), 341(SA), 342(CO), 343(ST), 344(ST), 345(ST), 346(IR), 347(IR), 348(CO), 349(ST), 350(HW), 351(HW), 352(SA), 353(SU), 354(HY), 355(PO), 356(CO), 357(HW), 358(HY).

DECEMBER: 359(AT), 360(SM), 361(HY), 362(HY), 363(SM), 364(HY), 365(HY), 366(HY), 367(SU)[c], 368(WW)[c], 369(IR), 370(AT)[c], 371(SM)[c], 372(CO)[c], 373(ST)[c], 374(EM)[c], 375(EM), 376(EM), 377(SA)[c], 378(PO)[c].

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JANUARY: 379(SM)[c], 380(HY), 381(HY), 382(HY), 383(HY), 384(HY)[c], 385(SM), 386(SM), 387(EM), 388(SA), 389(SU)[c], 390(HY), 391(IR)[c], 392(SA), 393(SU), 394(AT), 395(SA)[c], 396(EM)[c], 397(ST)[c].

FEBRUARY: 398(IR)[d], 399(SA)[d], 400(CO)[d], 401(SM)[c], 402(AT)[d], 403(AT)[d], 404(IR)[d], 405(PO)[d], 406(AT)[d], 407(SU)[d], 408(SU)[d], 409(WW)[d], 410(AT)[d], 411(SA)[d], 412(PO)[d], 413(HY)[d].

MARCH: 414(WW)[d], 415(SU)[d], 416(SM)[d], 417(SM)[d], 418(AT)[d], 419(SA)[d], 420(SA)[d], 421(AT)[d], 422(SA)[d], 423(CP)[d], 424(AT)[d], 425(SM)[d], 426(IR)[d], 427(WW)[d].

APRIL: 428(HY)[c], 429(EM)[c], 430(ST), 431(HY), 432(HY), 433(HY), 434(ST).

MAY: 435(SM), 436(CP)[c], 437(HY)[c], 438(HY), 439(HY), 440(ST), 441(ST), 442(SA), 443(SA).

JUNE: 444(SM)[e], 445(SM)[e], 446(ST)[e], 447(ST)[e], 448(ST)[e], 449(ST)[e], 450(ST)[e], 451(ST)[e], 452(SA)[e], 453(SA)[e], 454(SA)[e], 455(SA)[e], 456(SM)[e].

JULY: 457(AT), 458(AT), 459(AT)[c], 460(IR), 461(IR), 462(IR), 463(IR)[c], 464(PO), 465(PO)[c].

AUGUST: 466(HY), 467(HY), 468(ST), 469(ST), 470(ST), 471(SA), 472(SA), 473(SA), 474(SA), 475(SM), 476(SM), 477(SM), 478(SM)[c], 479(HY)[c], 480(ST)[c], 481(SA)[c], 482(HY), 483(HY).

SEPTEMBER: 484(ST), 485(ST), 486(ST), 487(CP)[c], 488(ST)[c], 489(HY), 490(HY), 491(HY)[c], 492(SA), 493(SA), 494(SA), 495(SA), 496(SA), 497(SA), 498(SA), 499(HW), 500(HW), 501(HW)[c], 502(WW), 503(WW), 504(WW)[c], 505(CO), 506(CO)[c], 507(CP), 508(CP), 509(CP), 510(CP), 511(CP).

OCTOBER: 512(SM), 513(SM), 514(SM), 515(SM), 516(SM), 517(PO), 518(SM)[c], 519(IR), 520(IR), 521(IR), 522(IR)[c], 523(AT)[c], 524(SU), 525(SU)[c], 526(EM), 527(EM), 528(EM), 529(EM), 530(EM)[c], 531(EM), 532(EM)[c], 533(PO).

NOVEMBER: 534(HY), 535(HY), 536(HY), 537(HY), 538(HY)[c], 539(ST), 540(ST), 541(ST), 542(ST), 543(ST), 544(ST), 545(SA), 546(SA), 547(SA), 548(SM), 549(SM), 550(SM), 551(SM), 552(SA), 553(SM)[c], 554(SA), 555(SA), 556(SA), 557(SA).

a. Presented at the New York (N.Y.) Convention of the Society in October, 1953.
c. Discussion of several papers, grouped by Divisions.
d. Presented at the Atlanta (Ga.) Convention of the Society in February, 1954.
e. Presented at the Atlantic City (N.J.) Convention in June, 1954.